



SUB-COMMITTEE ON FIRE PROTECTION  
46th session  
Agenda item 3

FP 46/3  
5 March 2001  
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**RECOMMENDATION ON EVACUATION ANALYSIS FOR  
NEW AND EXISTING PASSENGER SHIPS**

**Report of the working group at FP 45 (Part 2)**

**Submitted by the Chairman of the Working Group**

**SUMMARY**

***Executive summary:*** This document provides the outcome of the working group on evacuation analysis which met during FP 45.

***Action to be taken:*** Paragraph 12

***Related documents:*** FP 45/WP.6 and FP 45/16

**General**

1 The working group on evacuation analysis met from 9 to 10 January 2001 under the chairmanship of Mr. M. Dogliani (Italy).

2 The group was attended by representatives from the following Member Governments

BRAZIL  
CANADA  
DENMARK  
FINLAND  
FRANCE  
GERMANY  
GREECE  
ITALY

JAPAN.  
NETHERLANDS  
NORWAY  
POLAND  
SWEDEN  
UNITED KINGDOM  
UNITED STATES

and observers from the following non-governmental organizations in consultative status:

INTERNATIONAL ASSOCIATION OF CLASSIFICATION SOCIETIES (IACS)  
INTERNATIONAL COUNCIL OF CRUISE LINES (ICCL)

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## Terms of reference

3 The group was instructed by plenary to:

- .1 to continue work on the evacuation analysis guidelines for new passenger ships, using as a basis MSC/Circ.909 and taking into consideration the report of the correspondence group (FP 45/3/3), the relevant documents submitted to the session and the discussion in plenary;
- .2 to finalize work on the draft Guidelines for the evacuation analysis of high-speed passenger craft based on annex 1 of document FP 45/3/3, taking into consideration the outcome of MSC 73 with regard to survival craft on high-speed craft, and to prepare a covering draft MSC circular for their dissemination;
- .3 to further progress the development of the basic guidance on the use of microscopic models, taking into account documents FP 45/3 and FP 45/3/2 and any available information from ISO;
- .4 to further consider the matter on existing passenger ships with a view to developing a plan of action in this regard, taking into consideration the request of MSC 73 (MSC 73/21, paragraph 4.16) and comments made in plenary;
- .5 to advise on whether a Correspondence Group is necessary and, if so, prepare a recommendation regarding the terms of reference; and
- .6 to submit a report to plenary by Thursday, 11 January.

## Reports of the working group (part 1)

4 The group submitted its report (part 1) on the tasks specified in paragraph 3 above as instructed by plenary at FP 45 (FP 45/WP.6). The group continued to work through the week on the tasks specified in paragraph 3.1 and 3.3 above during the forty-fifth session of the Sub-Committee and submitted this report (part 2) to the forty-sixth session of the Sub-Committee. This document might also be used by the correspondence group in course of their work.

## Guidelines for evacuation analysis of new passenger ships

5 In addition to the comments and decisions provided in paragraph 4 of document FP 45/WP.6, the results of the group's work on this issue are summarised in the following paragraphs with a view of their consolidation and of providing input to the work of the intersessional correspondence group.

6 The issues related to MSC/Circ.909, as highlighted in the annex to document FP 45/3/4 (Germany), were analysed as follows:

6.1 The group discussed matters addressed in paragraph 2.1 of the annex to document FP 45/3/4, related to the calculation of the specific flow of persons, and agreed that this problem is likely to arise when a limited number of persons is considered on one branch of an escape route which merges with other branches. This could happen, for instance, when analyzing evacuation of crew areas. Possible solutions to deal with this issue are the definition of the minimum numbers of persons below which the problem arises and/or the inclusion, in the guidelines, of indications on how to avoid it.

6.2 The group noted that the transition points in the staircases do not take into account the chronological deviations of distantly related decks, as discussed in paragraph 2.2 of the annex to document FP 45/3/4, and agreed that:

- .1 this is an inherent limitation of the method used in MSC/Circ.909;
- .2 this limitation in the method is less significant for ro-ro passenger ships than for other passenger ships due to present requirements of SOLAS imposing maximum number of decks from embarkation stations; and
- .3 the matter of chronological deviations is also present in resolution A.757(18) and that it is tackled there by suitable reduction factors in the number of passengers and that this or a similar solution should be explored for the guidelines on evacuation analysis.

6.3 The group discussed the comments provided in paragraph 2.3 of the annex to document FP 45/3/4 related to the calculation of effective width and agreed that the use of the clear width, rather than the effective width as proposed in annex 3 to document FP 45/3/3, could solve this problem.

6.4 The group discussed the comments provided in paragraph 2.4 of the annex to document FP 45/3/4 related to the definition of speed and flow of persons and recalled that this definition, as proposed in table 1.4 of annex 3 to document FP 45/3/3, stems from SFPE Handbook of Fire Protection Engineering (see section 3, chapter 14). In the SFPE Handbook, both speed and flow are functions of the density and this does not produce problems in considering the initial movement of people. However, later on in the analysis, the group agreed that this problem does appear and has to be addressed in the new guidelines.

6.5 In considering the initial density of people, the group discussed the comments provided in paragraph 2.7 of document FP 45/3/1 (ICCL) and agreed that this point needs to be further addressed by correspondence group.

6.6 The matter of “flexibility of arrangements” was discussed and, in particular the group clarified that while at present this is included in the safety factor (see paragraph 3.8.1 of document MSC/Circ.909), it could be seen as an additional requirement on top of SOLAS. The group also noted that this was the background for the proposal (see annex 3 to document FP 45/3/3) to remove paragraph 3.8.1. However the group agreed that the matter would have to be dealt with by the correspondence group.

### **Basic guidance on the use of microscopic models**

7 In addition to the group’s comments and decisions on matters related to the basic guidance on the use of microscopic models, as contained in paragraphs 7 to 10 in part 1 of its report (FP/45/WP.6), the results of the group’s work on this issue are summarised in the following paragraphs.

8 The input parameters for use of a microscopic model were discussed and selected, based on the parameters provided in the annex to document FP 45/3 (United States). In order to facilitate their use for the definition of benchmarks, the parameters were grouped into four categories as used in other industrial fields (where the following groups are used: environmental, population, procedural and geometrical) and reworded as follows.

8.1 *Reaction time* (parameter 3.1.1\*). The group agreed that the description of the parameter will read “The range of passenger reaction times to an evacuation order” and that it is categorised as “population”. It was also noted that the definition for “reaction time” needed to be developed based on the definitions of “awareness time” and “response time” provided on paragraphs 4.1.1 and 4.1.2 of the annex to document FP 45/3.

8.2 *Passenger population* (parameter 3.1.2) and *Passengers wearing life jackets* (parameter 3.1.10). The group agreed to join these two parameters together as a single parameter described as “population demographics” which was categorised as “population”. It was also agreed that this parameter accounts for several different causes of reduced mobility of persons as gender, age and any causes of impairment of cognitive or movement capabilities such as alcohol intoxication, wearing of lifejackets, etc.

8.3 *Range of vessel motions* (parameter 3.1.3). The group agreed that the description of the parameter will read “Static and dynamic conditions of the ship” and that it falls under the “environmental” category. It was also agreed that when static conditions are representing the effect of an accident, no other accidental situation should be included in the benchmark as it is the general policy of IMO’s instruments not to consider multiple accidents in a same scenario.

8.4 *Type of deck surfaces* (parameter 3.1.4). The group agreed to remove this input parameter based on the consideration that it is too detailed.

8.5 *Levels of illumination* (parameter 3.1.5). The group agreed to further consider the removal of the parameter taking into account the following considerations:

- .1 a blackout is unlikely due to redundant illumination systems;
- .2 low location lighting is designed to be relevant only if smoke, and therefore fire, is present in the benchmark, but this will not be the case (see paragraph 8.6 below); and
- .3 the levels of illumination in the escape routes when the emergency power is used is similar to normal conditions and, therefore, no differentiation is needed in the definition of the benchmark.

8.6 *Smoke obscuration* (parameter 3.1.6). The group agreed to further discuss the possible removal of this parameter since it would produce multiple accidental situations (see also paragraph 8.3 above).

8.7 *Obstructions* (parameter 3.1.7) and *distribution* (parameter 3.1.14) of egress routes. The group agreed to further discuss whether to join the above parameters, to read “Distribution of evacuation routes, their obstruction and partial unavailability”. The group also agreed to further discuss whether that this should be categorised as “geometrical” to account for a variety of causes such as fire, operating sprinklers, as well as debris. The group agreed that this latter proposal needed further consideration and that proper definition should be developed by the correspondence group to the extent necessary.

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\* Numbers refer to the paragraphs contained in the annex to document FP 45/3.

8.8 *Level of communication* (parameter 3.1.8). The group agreed to the parameter being removed based on the consideration that it is assumed, for the purposes of carrying out the evacuation analysis, that communication is available as the system is redundant.

8.9 *Crew/passenger ratio* (parameter 3.1.9). The group agreed to modified this parameter to read “The crew members available to assist in an emergency” and to be categorised as “procedural”.

8.10 *Fire exposure* (parameter 3.1.11). The group agreed further consider the removal of this parameter based on the same considerations discussed in paragraph 8.6 above.

8.11 *Occupant distribution* (parameter 3.1.12). The group agreed to modify this parameter to read “Initial passenger and crew distribution conditions” and to categorise it as “geometrical”.

8.12 *Weather conditions* (parameter 3.1.13). The group agreed to remove this parameter since it is implicitly included under paragraph 8.3 above.

8.13 *Fire screen doors* (parameter 3.1.15). The group agreed to move this parameter under paragraph 8.7 above (once finalised).

9 The group agreed that the guidelines will have to specify sufficient benchmarks based on that which the acceptance of the design will be determined. The wording “benchmark” was used to reflect the fact that these will not be “worst case”. It was also agreed that each benchmark will have to be defined, based, inter alia, on the parameters listed in section 8 above, once finalised, to the extent necessary to make sure that a uniform application of the guidelines is obtained. This implies that, for each benchmark, suitable ranges of values of the above parameters will have to be defined and included in the guidelines.

10 The draft guidelines submitted by Germany (FP 45/3/2) were discussed in general terms and it was agreed that they contain very useful information and will have to be taken into account in the work by correspondence group together with document FP 45/3. In this respect, the group agreed that document FP 43/4/4 (Denmark, Finland, Norway, Sweden and Italy) will also have to be reconsidered as it provided information which is useful at this stage of development of the guidelines.

11 It was noted by the group that the annex to FP 45/3/2 provides elements of the implementation of a specific microscopic model and, as such, they were clarified to be an example of a microscopic model. Germany also clarified that the appendix was meant to be illustrative of a methodology.

12 The Correspondence Group should focus on formulating the Philosophy, Methodology, and Parameters to be used and develop criteria for the validation of the microscopic models. It was not the remit of the Group to develop the implementation of a model. These terms are loosely defined as follows:

- .1 *Philosophy and Methodology*: To identify the rationale and the approach that should be utilized in the developing a microscopic model. This would include for example that the microscopic model is capable of representing individual persons, is capable of representing space in a discrete way, includes relevant human behaviour characteristics and is capable of representing the interaction between space, people and human behaviour;

- .2 *Parameters:* To identify and quantify the factors which influence the evacuation process (e.g. speed of walking, distribution of the passengers and crew within the vessel, population demographics, and configuration of escape arrangements<sup>1</sup>);
- .3 *Validation:* The manner in which a particular implementation is shown to satisfy a range of agreed criteria; and
- .4 *Implementation:* The manner with which the philosophy, methodology, and parameters are represented in a specific computer model (e.g. the space is represented by a particular method, or indeed that space is represented by another suitable method).

13 It was agreed that the correspondence group should be invited to provide evidence that explains deviations from the basic documents listed under paragraph 10 above.

### **Input to the correspondence group**

14 The group agreed that the decisions and comments contained in paragraph 5 to 13 above provide additional input to the work correspondence group, re-established at FP 45, for their consideration and further development of the matters on evacuation analysis.

### **Action requested of the Sub-Committee**

15 The Sub-Committee is invited approve the report in general and take action as appropriate.

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<sup>1</sup>Discussion: SOLAS regulation II-2.28.1.3 requires “In addition, the analysis shall be used to demonstrate that escape arrangements are sufficiently flexible to provide for the possibility that certain escape routes, assembly stations, embarkation stations or survival craft may not be available as a result of a casualty”.